NISTTech

Real Time, Active Picometer-Scale Alignment, Stabilization & Registration in One or More Dimensions

Simple method to accurately position and stabilize microscopic structures

Description

Position and stabilize microscopic structures by attaching a fiducial mark to a sample and measuring the scattering of optical signals (e.g., as generated by a laser) off this mark. Align two or more in independent structures relative to each other, or relative to a shift of a known center, or raster scan structures with respect to each other.

A single laser beam can be used for the alignment, stabilization and registration of more than one structure. For example, one laser beam can measure the lens and the fiducial mark on the sample, or instead may be split to measure one fiducial mark on one sample, one fiducial mark on another sample (e.g., a mask), and the lens.

The signals are provided to a feedback processor to create an output related to the input signal from the photo-sensitive device. If the signals are not within a certain limit, then the position of at least one of the independent structures is varied such that the electrical signals are within the limits of the desired value. If the signal is within a desired threshold, the positioning remains unchanged. The laser light will be scattered off the two or more mechanically independent structures either continuously or within certain predefined intervals to ensure that the separation between the structures does not vary within predefined limits.

Note: Also see NIST docket 08-020, below under Citations.

Applications

- **Optics and microscopy**
  May be used in scanning probe microscopy, Atomic Force Microscopy (AFM) and optical microscopy
- **Semiconductors**
  Used in semiconductor patterning including semi-conductor wafer and mask alignment, and operating optical tweezers

Advantages

- **Decreases drift**
  Achieves accurate positioning and stabilization
- **Reduces or eliminates noise**

Abstract

A method and apparatus for aligning, stabilizing and registering two or more structures in one or more dimensional space with picometer-scale precision. Low noise laser light is scattered by at least one or more structure or fiducial marks. One mark may be coupled to each structure to be positioned. The light which has been scattered off the fiducial marks is collected in a photo-sensitive device which enables real-time high-bandwidth position sensing of each structure. One or more of the structures should be mounted on a stage, and the stage can move in either one or more dimensions. The photo-sensitive device generates signals in response to the scattered light received, and the signals are used to modulate the position of the stage in a feedback loop.

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Citations

1. NIST docket# 08-020

References

- U.S. Patent #7,928,409 issued 10-7-2010, expires 12/21/2029
- Docket: 05-019US

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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